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Media Data Protection

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Media Data Protection

BACKGROUND

This disclosure relates generally to game content security. Current game security mechanisms involve a specially formatted optical disk (e.g., DVD) media that ensures that it is prohibitively expensive to copy secure game content. Prior-art media protection (such as DVD, which means digital video disk or digital versatile disk) is based largely on making copying very difficult (e.g., by using encryption). Expensive equipment is used to produce and/or duplicate optical disks that have safeguarding mechanisms. The content of DVDs are thereby protected from copying based on the expense of copying or pirating the optical disk. Such a specially formatted executable that is stored within the DVD media contains a mechanism that allows the encryption to be performed within the actual executable.

Since copying disks is so difficult in certain prior-art systems, it is attractive for unauthorized user/players to modify media content. As such, the contents of a copied file containing game media can not be modified in certain embodiments of optical disks by, for example, copying an optical disk (e.g., burning a disk) that can copy the game content from another optical disk. Such expenses associated with the safeguarding mechanisms can be absorbed for more expensive games. For relatively inexpensive games however, such expenses are often cost prohibitive. Thus, it would be

1 beneficial to have a more cost-effective approach to securing game content
2 to reduce the possibility of modifying the game content.

3

4 **SUMMARY OF THE INVENTION**

5 This invention describes multiple embodiments of data protection.
6 One version of the data protection can be applied to game systems. In one
7 version, the data protection portion includes a file system alteration checking
8 portion. One aspect of the file system alteration checking portion relates to a
9 media including game content and a data protection portion. In one version,
10 the data protection portion protects the game content from modification by
11 determining whether the game content has been modified. If the game
12 content has been modified, then the use of the game content within the
13 apparatus fails. A data protection portion includes the file system alteration
14 checking portion.

15

16 **BRIEF DESCRIPTION OF THE DRAWINGS**

17 Throughout the drawings, the same numbers reference like features
18 and components.

19 Fig. 1 illustrates a block diagram of one embodiment of a game
20 console;

21 Fig. 2 illustrates a flow chart of one embodiment of media data
22 protection process that can run on the game console of Fig. 1;

23 Fig. 3 illustrates a flow chart of one embodiment of the media type
24 check as shown in Fig. 2;

1 Fig. 4 illustrates a flow chart of one embodiment of a file system
2 alteration check as shown in Fig. 2;

3 Fig. 5 illustrates a flow chart of one embodiment of the file signature
4 check as shown in Fig. 2;

5 Fig. 6 illustrates a general computer environment, which can be used
6 to implement the techniques described herein; and

7 Fig. 7 shows functional components of the game console located
8 within the computer environment of Fig. 6 shown in more detail.

9

10 **DETAILED DESCRIPTION**

11 In this disclosure, the term “optical media” includes, but is not limited
12 to, such media as digital video disk or digital versatile disk (DVD) and
13 compact disk (CD). The term “removable media” includes optical as well as
14 magnetic media. The term “file” and “file system” relates generally to the
15 logical layout of data on removable media. The terms “sectors” and “cluster
16 of sectors” includes the physical layout of data on the removable media
17 wherein a plurality of sectors are included in a cluster of sector. The term
18 “cluster of data” refers to the physical layout in which data is stored. The
19 term “executable” includes the code that runs from media, removable or
20 fixed, that can access other data files. The term “data files” includes files
21 that contain data corresponding, e.g., to text files, art files, etc. that are used
22 by the executable file in the course of operation.

23 One aspect of this disclosure relates to security aspects of a game
24 console 102 of Fig. 1, such as the Xbox® video game system (manufactured
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1 and distributed by Microsoft Corporation). This disclosure details multiple
2 embodiments of a media data protection process 200 such as described
3 relative to Fig. 2. Using the media data protection process 200 increases the
4 security against modification of the media content 109 (i.e., data or
5 executable code) for the game console 102 released by software distributors.
6 The media data protection process 200 can be used with non-standard media
7 as well as standard removable media 108 for the game console 102.

8 One embodiment of the game console 102 as described in Fig. 1
9 includes a system memory 114 that interfaces with a removable media 108.
10 The removable media 108 can be a digital video disk (DVD), a compact disk
11 (CD), a floppy disk, or any other memory device that can be inserted in the
12 game console 102 for storing media content 109. The most applicable
13 currently-used removable media 108 is the DVD, but it is envisioned that
14 other types of removable media 108 that are being developed or were
15 developed previously) are within the intended scope of the present
16 disclosure. Removable media are most applicable to the different
17 embodiments of the media data protection processes because removable
18 media are relatively easy for an unintended third party to modify (such as in
19 a remote computer).

20 Different embodiments of the media content 109 to be played on the
21 game console 102 can contain game content 110. In this disclosure, the term
22 “media content” applies to code, information, images, and/or other data that
23 applies to a game that can be played on the game console 102. For example,
24 the media content 109 to be played on a game console 102 can include, but
25

1 is not limited to, game content 110 and such non-game content 112 as movie
2 content, music content, audio content, video content, video conferencing
3 content, and/or digital video disk (DVD) content. The game content can
4 also include, e.g., vehicles, characters, weapons, spells, levels, updated
5 statistics, or other such graphically displayable or game usable information
6 that applies to any particular game to be played on a game console that is
7 generally known to user/players of game consoles.

8 In this disclosure, the media content 109 can include any game
9 content 110 that can optionally be combined with non-game content 112.
10 The game consoles and the media are configured to provide access to both
11 types of content.

12 A plurality of distinct media data protection processes as described in
13 this disclosure reduces the modification of the media content 109. These
14 media data protection processes are illustrated in Fig. 2 and include: (1) a
15 media type check 300, one embodiment of which is described relative to Fig.
16 3; (2) a file system alteration check 480, one embodiment of which is
17 described relative to Fig. 4; and (3) a file signature check 450, one
18 embodiment of which is described relative to Fig. 5. These three checks
19 300, 450, and 480 can be run in any order or combination. Not every check
20 is essential for every embodiment of media data protection process. In
21 different embodiments of the disclosure only one check may be performed,
22 two of the three checks may be performed, or all three checks may be
23 performed.

1 In one embodiment of the media type check 300, the media data
2 protection process determines whether the type of media is as expected for
3 the executable, and therefore determines whether the media content has been
4 copied to an unauthorized type of media. As such, within certain
5 embodiments of the media data protection process 200 the data protection
6 portion reduces the possibility of allowing game content copied from a
7 pressed optical disk to an end user/player writable disk from being executed
8 from the user/player writable disk.

9 One embodiment of the file system alteration check 480 checks
10 whether the file has been altered in an unauthorized manner such as a size or
11 location change of a file in the disk layout. In addition, the file system
12 alteration check can detect file content changes (which is also accomplished
13 by the file signature check).

14 In one embodiment of the file signature check 450, the media data
15 protection process checks whether the content of a file is as expected based
16 on the file signature being as expected. Modification of the file content
17 would alter the signature. As such, the file signature check reduces the
18 possibility that the file has been modified.

19 Certain embodiments of checks 300, 450, and 480 are described in
20 this disclosure. After the media type check 300 is satisfactorily run, the
21 game executable 220 is launched (or continued if it has already been
22 launched). After the file signature check 450 is satisfactorily run, the game
23 executable 220 and/or the non-game executable is launched (or continued if
24 already launched).

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1 After the file system alteration check 480 is satisfactorily run, the non-
2 game executable 222 and/or the game executable 220 is launched (or
3 continued if it already has been launched). In one embodiment, if at least
4 one of the media type check 300, the file system alteration check 480, and
5 the file signature check 450 is unsuccessfully run (as described herein
6 relative to respective Figs. 3, 4, and 5) then the respective executable is not
7 launched, or can be terminated if already launched.

8 One embodiment of the media type check 300 is illustrated in Fig. 3.
9 For the game console, the media type is stored in the actual executable file
10 itself. In the media type check 300, the standard executable is located
11 (found) on the media in 302. In 304, a media type allowed flag is read from
12 the standard executable that was located in 302. The media type allowed
13 flag indicates the type of media on which the executable should be located.
14 Practically, 304 can be performed many times for each time 302 is
15 performed.

16 In decision 306, the game console 102 determines whether the media
17 type allowed flag is set. If the answer to decision 306 is no, then the media
18 type check continues to 314. If the answer to the decision 306 is yes, then
19 the media type check 300 continues to 308 in which the media containing
20 the executable is read to detect and return the type. The media type check
21 continues to 309 in which the media type is read from the standard
22 executable.

23 The media type check 300 continues to 310 in which the game
24 console 102 determines whether the media definitions of the executable
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1 match that of the media. If the answer to decision 310 is no, then the media
2 type check 300 continues to 316. In 316, the executable fails to launch if it
3 has not already been launched. Alternatively in 316, the executable
4 discontinues the execution of the executable if the executable has been
5 launched. If the answer to decision 310 is yes, then the media type check
6 continues to 314 in which the executable is launched if the executable has
7 not already been launched. If the executable has already been launched,
8 then the execution of the executable is continued.

9 The media type allowed flag indicates a type of media that the
10 executable should be contained within (and optionally also indicates that the
11 check should be performed). If the media type of the executable does not
12 match the media type of the media, as determined in decision 310, then the
13 media type check continues to 316 in which the media type check 300 fails,
14 and the executable is not launched. This process will then be terminated
15 since the game console 102 cannot launch the executable.

16 For one example of media type checking, when a user/player inserts a
17 removable media 308 such as a DVD, the game console will check the type
18 of standard executable (e.g., DVD-5 or DVD-R as illustrated in Table 1
19 below). Such media as DVDs come in a range of physical formats with
20 differing capacities and costs associated with their production. DVDs often
21 have the same dimensions as a CD, but each DVD is created with two
22 polycarbonate substrates that are bonded together like a sandwich. This
23 allows the opportunity to have disks with up to two sides and possibly four
24 readable surfaces as shown in Table 1.

1 Two embodiments of the DVD media are described within Table 1
2 (DVD-5 and DVD-R). DVD-5 is created using specially manufactured
3 equipment, and is currently often relied on by game manufacturers to
4 produce the original media disk. The media type checking 300 ensures that
5 the media type matches that media which was originally used to produce the
6 disk. If the originally produced disk is in the DVD-5 format, then the media
7 type allowed flag indicates the DVD-5 type. If the game is then placed on a
8 DVD-R disk (e.g., by an unauthorized user/player burning a copy of the
9 DVD), then the media type check 300 fails since the expected type of media
10 (i.e., DVD-5) does not match the actual type of media (i.e., DVD-R).

11 Table 1 - DVD Formats

12 Name	13 Capacity (GB)	14 Layers	15 Sides	16 Operation
17 DVD-5	18 4.7	19 1	20 1	21 This media can be read from one side 22 only. It is inexpensive to buy and 23 produce, but can only be created using specialist pressing machinery.
24 DVD-R	25 4.7 to 9.4	26 1	27 1 or 2	28 This media can be read from up to 2 29 sides of 1 layer. It is inexpensive to 30 produce and can be written to by 31 readily accessible burners. This is 32 typically the type of media used by 33 home PCs.

1 Within the file system alteration check, the root directory for the
2 Xbox® video game system takes a user/player to where the files are stored
3 where the executable file is being checked for the media type in the media
4 type check. In one embodiment, the root directory for the game media
5 content contains the game console executable files. The root directory
6 becomes important because this is where the game console searching for the
7 game media content expects to find its executable files.

8 Adding the media type check as shown in Fig. 3 to the game
9 launching executable file disallows execution from any media other than that
10 defined in the file (e.g. pressed DVD-5). Therefore, an unauthorized
11 user/player can not just make a copy of the ISO (Disk image file) and burn it
12 to DVD-R – having the executable on a DVD-R will prevent the executable
13 from being executed. The code responsible for launching the executable file
14 that includes the media type check 300 therefore checks the disk type and
15 enforces the media type check 300 before playing the media on the game
16 console 102.

17 Once the media type (that is determined to be correct for the game
18 console) is confirmed using the media type check 300, then in one
19 embodiment the executable is launched. This step can be used either to open
20 the data file, copy the data files to a hard drive, read certain sectors of the
21 data file, or perform a similar routine.

22 The combination of additional media data protection mechanisms will
23 be determined by the file read access profile of the actual game being
24 protected. Detection of the profile does not need to be done real time, and
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1 can be done as part of the development and shipped as data with the
2 executable. The profiling indicates the applicable types of media data
3 protection process 200 for a particular game. The profile of security will be
4 obtained, and it can be determined which security method of the media data
5 protection process 200 to use for peak performance on the game cycle.

6 While the embodiment of media type check 300 described relative to
7 Fig. 3 compares different types of DVD media (i.e., DVD-5 and DVD-R),
8 this particular implementation of the media type check is illustrative in
9 nature and not limiting in scope. It is intended that a similar media type
10 check can be applied to any type of formatted media in which the media
11 producers typically produce their media in one particular format.

12 Certain embodiments of media data protection process 200, as
13 illustrated in Fig. 2, also include the file system alteration check 480 as
14 shown in Fig. 4. In general, the file system alteration check may be viewed
15 as checking the physical layout of the disk. The file system alteration check
16 generally works on clusters of data at a sector level and utilizes the physical
17 media (e.g., checksums of the layout of the binary on the physical media).
18 The embodiment of the file system alteration check 480 includes an attempt
19 to mount the file system segment 481 and an attempt to read a cluster of
20 sectors from a media segment 491 that are arranged in series in Fig. 4. Both
21 the attempt to mount the file system segment 481 and the attempt to read
22 cluster of sector from a media segment 491 generally operate by attempting
23 to match an actual signature with an expected signature.

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1 In one version, the media type check 300 as described relative to Fig.
2 1 may be considered as a check of the format and contents of the entire
3 removable optical media 108 as shown in Fig. 1. The file system alteration
4 check 480 as described relative to Fig. 2, by comparison, may be considered
5 as the a check on the format and contents of the files that are stored on the
6 removable optical media 108 as shown in Fig. 1.

7 The attempt to mount the file system segment 481 may be considered
8 as an attempt run a first executable (i.e., the installer) that installs another
9 executable (i.e., the media content 109). The attempt to read a cluster of
10 sector from a media segment 491 may be considered as a piecemeal
11 comparison of a large number of actual signatures to a large number of
12 expected signatures (that correspond to the number of cluster of sector). Not
13 all sectors needs to be checked, the developer may configure which checks
14 to run at any point in the execution of the application. Certain embodiments
15 of attempting to install the file system segment 481 compares a single
16 expected signature to a single actual signature (that corresponds to the Table
17 of Contents for the disk). Alternatively, the attempt to read sectors of data
18 from game content data segment 491 may have to read many clusters of data
19 since a reasonable amount of data such as used for games (for example,
20 1Mbyte of data) can have a considerable number of sectors and a
21 considerable amount of data. As such, quick checks of many (if not all) of
22 the cluster of sectors are important in the attempt to read data and/or sectors
23 of data from game content data segment 491 in the attempt to install the file
24 system segment 481.

1 There are a variety of storage media sector and sector configurations
2 that the present disclosure concerns. Data is stored on DVDs using a variety
3 of file formats including the Universal Disk Format (UDF) which is a file
4 system chosen for DVD which would suit both read-only and writable
5 versions. UDF is based on the standard International Standards
6 Organization (ISO) 13346. There is a modified version of UDF that is
7 applicable to game consoles.

8 In one embodiment, the directory structure of a DVD disk uses two
9 directories, a Video_TS directory and an Audio_TS directory. The
10 Video_TS directory is automatically read by DVD video readers and thus
11 must be present in this security method to ensure the resulting disk will play
12 in standard readers as well as the game console 102. An exemplary DVD
13 directory structure using UDF is shown in Table 2. The description of UDF
14 is meant to be illustrative as software that can be used by computers and/or
15 game consoles in general.

16 Table 2 - File Formats

Optical Disk Root					
	Sub Directory One	Sub Directory Two	Sub Directory Three	Sub Directory Four	Sub Directory Five
Name	Other 1	Video_TS	Audio_TS	Other 2	Other 3
Content type	Optional	Video Files	Audio Files	Optional	Optional

1 In one version, the attempt to install the file system segment 481
2 allows a user/player to install the file. The attempt to install the file system
3 segment 481 starts with 482 in which the expected signature for the table of
4 contents is acquired from some secure means (typically using encryption).
5 The signature of the table of contents is read. In 484, the actual signature of
6 the table of contents is compared with the expected signature of the table of
7 contents. Following 484, the attempt to install the file system segment 481
8 continues to decision 485 in which it is determined whether there is a match
9 between the actual signature of the table of contents and the expected
10 signature of the table of contents.

11 If decision 485 concludes that there is no match, then the file system
12 alteration check 480 terminates at 486 in which the file is not installed. If
13 decision 485 concludes that there is a match, then the file system alteration
14 check 480 continues to 488 in which the file is installed, at which time the
15 file system alteration check 480 continues or starts to attempt to read data
16 from the game content data segment 491.

17 The attempt to read sectors of data from the game content data
18 segment 491 starts with 492 in which the actual signature is calculated or
19 read from the table of contents for every cluster of sector read. In one
20 implementation, the file system checks the signature for each sector or group
21 of sectors as they are read. In one version, the sectors of the media are read
22 for each cluster of sectors.

23 In 494, the actual signature and the expected signature are compared
24 for each cluster of sector read. The attempt to read data from the game

1 content data segment 491 continues to 495 in which it is determined whether
2 the actual signature matches the expected signature for each cluster of
3 sectors.

4 If the decision 495 determines that the actual signature matches the
5 expected signature, then the file system alteration check 480 continues to
6 498 in which the cluster of sector are read from the media. During the
7 reading of the cluster of sector from the media, the executable file is
8 launched if not already launched, or the execution of the executable file is
9 continued if previously launched.

10 If the decision 495 determines that the actual signature does not match
11 the expected signature for any one of the cluster of sector, then the file
12 system alteration check 480 continues to 496 in which the sectors of data are
13 failed to be read from the media. If the sectors of data are not read from the
14 media for any cluster of sector, then the executable is not launched and/or
15 the operation of the already executing executable file is discontinued.

16 As such, if the expected file signatures do not conform to the actual
17 signatures that the game console expects at any point during the file system
18 alteration check, the file system alteration check could abort the running of
19 the game content 110 or the non-game content 112 (depending on the
20 software designer) in the removable media 108.

21 Certain embodiments of media data protection process 200, as
22 illustrated in Fig. 2, also includes the file signature check 450 as shown in
23 Fig. 5. In general, the file signature check 450 refers to the logical layout of
24 the media. The file signature check utilizes encryption techniques of logical
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1 files. The file signature check 450 includes 452 in which the game-play
2 executable makes a request for a data file to be accessed. In 454, the game
3 data file is located on the disk and its signature is read from the disk. The
4 file signature check 450 continues to 456 in which the data file signature
5 located in 454 is compared against the expected data file signature for that
6 file.

7 The file signature check 450 continues to decision 458 in which it is
8 determined whether the data file signature located in 454 matches the
9 expected signature for that file. If the answer to decision 458 is no, then the
10 file signature check 450 continues to 462 in which the data file is not
11 provided access to continue. If the answer to decision 458 is yes, then the
12 file signature check 450 continues to 460 in which the data file is provided
13 access to continue.

14 Certain embodiments of the removable media 108 provide the
15 user/player benefit of being able to easily transfer files from one game
16 console to another. Such removable media 108 also provides the challenge
17 that certain user/players may wish to copy the files from one disk to another
18 disk, and some unauthorized user/players may wish to modify the contents
19 of the game content. The present disclosure provides a mechanism that
20 reduces the possibility of allowing such modified game content files to
21 execute.

22 For example, modification of the executable on the disk could allow
23 certain unapproved third party applications to be booted on the game
24 console. This modification of the executable can be done in prior art
25

1 systems by opening the box of the game console and modifying hardware.
2 Once media content (such as on an optical disk) is modified, the media
3 content can easily be copied and, for example, distributed on copied discs or
4 via the Internet. By employing the media data protection process 200
5 described herein, such modifications can be protected against (by not
6 allowing such content to be executed or accessed on the game console).

7 It is envisioned that combining a variety of different types of media
8 contents 109 on the removable media 108 can provide an improved
9 experience for the user/player of the game console 102 (e.g., a more
10 multimedia experience or a more varied experience). For example, assume
11 that a particular removable media 108 (e.g., an optical disk or DVD) for a
12 game console 102 includes the game content 110 based on a theme of a
13 movie.

14 It would likely make it more attractive for a user/player of the
15 removable media 108 to receive such additional non-game content 112 on
16 the removable media 108 as additional scenes of the movie, clips of making
17 the movie, a video of a band making music for the movie, and so forth.
18 These types of non-game content 112 are contained on the same removable
19 media 108 as the game media 110 to be played by the game console 102.
20 Similar multimedia media (DVD) could be produced for a variety of
21 scenarios.

22 In this disclosure, the term “multimedia” relates to a removable media
23 108 including a plurality of types of media content. The media content 109
24 that is contained on the removable media 108 can include game content 110,
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1 non-game content 112, or a combination of game content 110 and non-game
2 content 112. The media content 109 is developed by the software developer
3 and can be played by a user/player within the game console 102.

4 As such, media content 109 (including a combination of game content
5 110 and non-game content 112) being played on a game console 102 acts to
6 transform the game console 102 into a true multimedia device. Multimedia
7 aspects of the game console apply to games, sporting events, entertainment,
8 video conferencing, and so forth, as well as any combination of these. A
9 user/player could therefore view non-game media as well as game media by
10 inserting a disk such as a DVD within the game console 102. The game
11 console 102 therefore can be used as an interactive home entertainment
12 center.

13 The cost of making the removable media 108 to be used with game
14 consoles 102 is typically more expensive than the media used for such non-
15 game console applications (such as normal DVDs or CDs). User/players
16 typically have a better experience with (and are willing to pay more for)
17 removable media 108 to be played on the game console 102 compared with
18 removable media to be played on traditional DVD or CD players largely
19 because of the high degree of interactivity available on the game console. A
20 downside of producing relatively expensive games on removable media is
21 that the expense of a game media disk (or multimedia disk) makes it more
22 attractive for pirates and hackers to produce media knock-offs and other
23 inexpensive modified copies of the game media disks.

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1 It is also attractive for certain unauthorized user/players to modify the
2 game content to be configured to play on unauthorized disks. Such
3 unauthorized modification of game content by copying and modifying the
4 disk, in general, is providing a major challenge for the game, movie,
5 computer, home entertainment, sports, music, and other entertainment
6 industries. By employing the media data protection process 200, such
7 unauthorized modifications can be protected against (by not allowing such
8 files to be executed or accessed on the game console).

9 Certain aspects of this disclosure relate to security aspects of the
10 media content 109 for game consoles 102 as provided by the media data
11 protection process 200. The security aspects act to reduce unauthorized
12 modification of the media content 109 within the removable media 108 (and
13 also provide some protection against copying). One aspect of this disclosure
14 relates to the security aspects of the removable media 108 (including a CD, a
15 DVD, or any other type of media storage device) containing one or more
16 types of media content 109. The game content 110 and the non-game
17 content remain more secure within the removable media 108 for the game
18 console 102. Relatively inexpensive media 108 may be used to distribute
19 demonstration game media versions compared with a more expensive actual
20 game version. Since demos and the like may be on a type of game media
21 that does not include the rigid formatting as with more expensive games, the
22 code on the demos can be modified. Such modification of relatively
23 inexpensive game media (with less restrictive formatting) can, under certain
24 instances, be used to inject code into the game systems that acts to defeat the
25

1 game systems. With present configurations of media data protection
2 processes, the transfer of modified files that compromise the security of the
3 game console 102 will be greatly reduced. The disclosure enables
4 combining diverse types of game content 110 more securely with certain
5 types of non-game content 112 (e.g., music and movies).

6 Certain embodiments of the game console described in this disclosure
7 allow the playback of game content 110 simultaneous with the playback of
8 the non-game content 112. Such playback occurs without requiring the use
9 of expensive specially formatted DVD media.

10 Game consoles 102 exist in a cost-competitive field. In certain
11 embodiments, the game content 110 can be shipped at a reasonably low cost,
12 while the non-game content 112 included with the removable media 108
13 provides extra value to the removable media 108 and the game console. The
14 inclusion of the non-game content 112 with the game content 110 provides
15 an incentive for the user/player to purchase the removable media 108 (e.g.,
16 DVD) containing the media content 109, and not just modify the content of
17 the media. For instance, in a game console being used for a car racing game,
18 additional non-game content such as statistics of current drivers, video clips
19 of an actual car racing circuit with actual car racing drivers, etc. could well
20 enhance the user/player's experience.

21 In certain embodiments of the present disclosure, if an unauthorized
22 user/player could modify the game content 110 and non-game content 112
23 from a media (e.g., by burning the DVDs), then it would be less attractive
24 for that user/player to purchase a legitimately produced disk. Certain media
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1 content 109 that includes the game content will only play in a closed
2 platform that does not allow data downloads. Such reduction of the content
3 of the removable media 108 that can be modified or copied to another media
4 makes the original media more attractive, which means that user/players will
5 want to use the original disk instead of modifying the content of the disk.

6 Game content 110 can be distributed with such non-game content as
7 movies and music. As such, a user/player can interface with a variety of
8 types of media content 109 using the game console 102 instead of a single
9 type of media content (game content). This interaction with multiple types
10 of media content does not compromise the integrity of the game console 102
11 such as would occur by exposing the media content to external hacks that
12 exist with networked personal computers.

13 Optical disks such as DVDs have become the media of choice for
14 such game consoles 102 as the Xbox® video game system. It is envisioned,
15 however, that any removable media 108 that can run on the game console is
16 within the scope of the present disclosure. As such, one embodiment of this
17 disclosure provides the media data protection process that protects data from
18 a hacker. Different embodiments of the media data protection process 200
19 can be applied to virtually any media. The media type is important to
20 consider relative to the media data protection process 200 in that certain
21 media can be modified much easier than other media.

22 There are advantages to applying the media data protection process
23 200 to certain embodiments of the game console 102 instead of, for
24 example, a personal computer (PC) or a laptop computer. For computers
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1 that are not game consoles 102, the value of the media data protection
2 process may be less valuable because, for example, security can be added to
3 a typical computer such as a PC or laptop computer using a software
4 firewall. Game consoles are less expensive than PCs or laptop computers,
5 and as such sometimes cannot support as sophisticated of a security
6 mechanism as a firewall. Certain embodiments of the game console 102 are
7 a closed platform. A user/player cannot download data that is not authorized
8 by the producer of such a closed-platform game console 102 into the game
9 console.

10 Certain data downloads for the media data protection process 200 are
11 considered desirable. A producer of the game console may authorize the
12 user/player of certain types of data downloads (such as downloads that alter
13 the statistics and players of a football team for a football video game) by
14 storing this type of data in a form that can be readily modified. A producer
15 of a game console may not store other types of data (such as data that
16 provides a more complete multimedia experience for the game media) in a
17 form that permits easy modification. As such, the producer of a game
18 console, as well as a software developer and/or hardware developer for the
19 game console, can produce their products such that certain types of data
20 relating to the game can be easily modified, while other types of data is
21 much more difficult to modify. In all cases, the unauthorized modification
22 of this data is not desirable for the producer of a game console.

23 Many current game consoles 102 can physically play CDs including
24 the audio. To play a DVD movie in the game console 102, additional
25

1 external hardware may be needed. In the Xbox® video game system
2 embodiment of game console, for example, a remote control and a dongle
3 are used to play a DVD on a game console. The dongle incorporates
4 components that allow the DVD content to be decoded and played back.
5 Alternatively, some game consoles 102 may not use any such external
6 hardware. In certain embodiments, the code associated with the DVD could
7 be packaged on such a media as a DVD disk itself to allow the DVD disk to
8 run on the game console 102 (so there is no need for the traditional DVD
9 remote).

10 In general, before using any file, one embodiment of the media data
11 protection processes 200 as illustrated in Fig. 2 is performed. In certain
12 embodiments, it is not desired to transfer any file to the memory location in
13 the game console 102 prior to the media data protection processes 200 being
14 performed.

15 With a relatively small program, a content developer/designer or game
16 console developer/designer may wish to copy the media to the system
17 memory 114, check the system memory 114 for files, check the files for data
18 types, check for signatures on the files, and then no additional checks of the
19 files need be performed. With a frequently accessed file, a particular file is
20 checked once as it is copied to the hard drive, and after it is stored on the
21 hard drive it does not have to be checked again. Another technique is to
22 cache which checks have been performed and stack rank the importance of
23 re-doing the check. This means the check may not be performed every time
24 the file is accessed, but is always performed first time it is accessed.

25

1 With a large program, the security check(s) for the files are performed
2 as the files are used. Depending on performance considerations, the
3 developer may optionally have multiple checks performed concurrently
4 using parallel computing techniques.

5 The number of checks to be performed on a file can be a performance
6 consideration. For frequently accessed files, or small files, the data for the
7 files may be stored at a predetermined location on the hard drive instead of
8 reading the files from the removable media. For each file access, the files
9 can be checked to make certain that they contain that data which they should
10 contain (e.g., for a data file at the beginning of a program, the signature
11 could be checked for that file when execution of the program begins). As
12 the data is then stored on the hard drive, subsequent access to the data can be
13 performed without repeating the checking.

14 Using the media data protection processes 200, it is envisioned that a
15 game console such as the Xbox® video game system can therefore securely
16 run movies, videos, DVDs, and a wide variety of media. As use of game
17 consoles using the media data protection processes 200 becomes more
18 accepted and understood, the scope of the game console applications will
19 increase. The game console can provide a variety of entertainment solutions
20 rather than just game solutions. The security issues for the game console
21 remains similar whether being used as a more inclusive entertainment
22 solution or a directed game solution.

23 A user/player can view and interact with a game console having
24 improved multimedia aspects by illustrating a sporting event, a concert
25

1 event, or a theater event using the game console so the user/player can
2 control certain aspects of where the user/player is located (based on the
3 display of the game console) in a particular venue. For example, a
4 user/player could control whether they were viewing a concert from the front
5 row, the back row, or on the stage. In traditional videos, the viewer of a
6 movie, concert, or game is positioned where the camera is located. As such,
7 the game console 102 can be used for interactive concerts and sports events
8 whereby a user/player of the game console 102 is allowed to move anywhere
9 they wish within the auditorium, concert venue, sports arena, or the like.
10 The interactivity provided to certain embodiments of game console allows
11 virtual user/players to appear in the game console 102 to stand on the stage
12 next to a performer or sports figure (if so desired), or alternatively move
13 further away. Another virtual user/player can appear in the game console
14 102 to move around relative to a football player, tennis player, golfer,
15 baseball player at different distances there from. The interactivity provided
16 to different user/players of the game console therefore becomes
17 considerable.

18 The producer of the media content 109 for a particular removable
19 media 108 would therefore collaborate with, for example, the artist or player
20 to provide the game content 110 and the non-game content 112 to be
21 included on the removable media 108. The removable media 108 (e.g., CD
22 or DVD) associated with the media content 109 is formatted and recorded in
23 a particular manner to allow this type of translation around the auditorium.
24 While this removable media 108 formatting can be done on a computer such
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1 as a personal computer (PC), game consoles 102 typically have less memory
2 capabilities. Providing such a variety of media content 109 to be provided
3 for the removable media 108 for a game console 102 has many fascinating
4 potential applications.

5 Fig. 6 illustrates a general computer environment 500, which can be
6 used to implement the game console 102 techniques described herein. The
7 computer environment 500 is only one example of a computing environment
8 and is not intended to suggest any limitation as to the scope of use or
9 functionality of the computer and network architectures. Neither should the
10 computer environment 500 be interpreted as having any dependency or
11 requirement relating to any one or combination of components illustrated in
12 the exemplary computer environment 500.

13 The computer environment 500 includes a general-purpose computing
14 device in the form of a computer 502 that can be used to provide the game
15 console 102. Computer 502 can be, for example, a game console as shown
16 in Fig. 1. The components of computer 502 can include, but are not limited
17 to, one or more processors or processing units 504 (optionally including a
18 cryptographic processor or co-processor), the system memory 506 (that may
19 include all, or a portion of, the system memory 114 of Fig. 1), and a system
20 bus 508 that couples various system components including the processor 504
21 to the system memory 506.

22 The system bus 508 represents one or more of any of several types of
23 bus structures, including a memory bus or memory controller, a peripheral
24 bus, an accelerated graphics port, and a processor or local bus using any of a
25

1 variety of bus architectures. By way of example, such architectures can
2 include an Industry Standard Architecture (ISA) bus, a Micro Channel
3 Architecture (MCA) bus, an Enhanced ISA (EISA) bus, a Video Electronics
4 Standards Association (VESA) local bus, and a Peripheral Component
5 Interconnects (PCI) bus also known as a Mezzanine bus.

6 Computer 502 typically includes a variety of computer readable
7 media. Such media can be any available media that is accessible by
8 computer 502 and includes both volatile and non-volatile media, removable
9 and non-removable media.

10 The system memory 506 includes computer readable media in the
11 form of volatile memory, such as random access memory (RAM) 510,
12 and/or non-volatile memory, such as read only memory (ROM) 512. A basic
13 input/output system (BIOS) 514, containing the basic routines that help to
14 transfer information between elements within computer 502, such as during
15 start-up, is stored in ROM 512. RAM 510 typically contains data and/or
16 program modules that are immediately accessible to and/or presently
17 operated on by the processing unit 504.

18 Computer 502 may also include other removable/non-removable,
19 volatile/non-volatile computer storage media. By way of example, Fig. 6
20 illustrates a hard disk drive 516 for reading from and writing to a non-
21 removable, non-volatile magnetic media (not shown), a magnetic disk drive
22 518 for reading from and writing to a removable, non-volatile magnetic disk
23 520 (e.g., a “floppy disk”), and an optical disk drive 522 for reading from
24 and/or writing to a removable, non-volatile optical disk 524 such as a CD-
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1 ROM, DVD-ROM, or other optical media. The hard disk drive 516,
2 magnetic disk drive 518, and optical disk drive 522 are each connected to
3 the system bus 508 by one or more data media interfaces 526. Alternatively,
4 the hard disk drive 516, magnetic disk drive 518, and optical disk drive 522
5 can be connected to the system bus 508 by one or more interfaces (not
6 shown).

7 The disk drives and their associated computer-readable media provide
8 non-volatile storage of computer readable instructions, data structures,
9 program modules, and other data for computer 502. Although the example
10 illustrates a hard disk 516, a removable magnetic disk 520, and a removable
11 optical disk 524, it is to be appreciated that other types of computer readable
12 media which can store data that is accessible by a computer, such as
13 magnetic cassettes or other magnetic storage devices, flash memory cards,
14 CD-ROM, digital versatile disks (DVD) or other optical storage, random
15 access memories (RAM), read only memories (ROM), electrically erasable
16 programmable read-only memory (EEPROM), and the like, can also be
17 utilized to implement the exemplary computing system and environment.

18 Any number of program modules can be stored on the hard disk 516,
19 magnetic disk 520, optical disk 524, ROM 512, and/or RAM 510, including
20 by way of example, an operating system 526, one or more application
21 programs 528, other program modules 530, and program data 532. Each of
22 such operating system 526, one or more application programs 528, other
23 program modules 530, and program data 532 (or some combination thereof)

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25

1 may implement all or part of the resident components that support the
2 distributed file system.

3 A user/player can enter commands and information into computer 502
4 via input devices such as a keyboard 534 and a pointing device 536 (e.g., a
5 “mouse”). Other input devices 538 (not shown specifically) may include a
6 microphone, joystick, game pad, satellite dish, serial port, scanner, and/or
7 the like. These and other input devices are connected to the processing unit
8 504 via input/output interfaces 540 that are coupled to the system bus 508,
9 but may be connected by other interface and bus structures, such as a
10 parallel port, game port, or a universal serial bus (USB).

11 A monitor 542 or other type of display device can also be connected
12 to the system bus 508 via an interface, such as a video adapter 544. In
13 addition to the monitor 542, other output peripheral devices can include
14 components such as speakers (not shown) and a printer 546 which can be
15 connected to computer 502 via the input/output interfaces 540.

16 Computer 502 can operate in a networked environment using logical
17 connections to one or more remote computers, such as a remote computing
18 device 548. By way of example, the remote computing device 548 can be a
19 personal computer, portable computer, a server, a router, a network
20 computer, a peer device or other common network node, game console 102,
21 and the like. The remote computing device 548 is illustrated as a portable
22 computer that can include many or all of the elements and features described
23 herein relative to computer 502.

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1 Logical connections between computer 502 and the remote computer
2 548 are depicted as a local area network (LAN) 550 and a general wide area
3 network (WAN) 552. Such networking environments are commonplace in
4 offices, enterprise-wide computer networks, intranets, and the Internet.

5 When implemented in a LAN networking environment, the computer
6 502 is connected to a local network 550 via a network interface or adapter
7 554. When implemented in a WAN networking environment, the computer
8 502 typically includes a modem 556 or other means for establishing
9 communications over the wide network 552. The modem 556, which can be
10 internal or external to computer 502, can be connected to the system bus 508
11 via the input/output interfaces 540 or other appropriate mechanisms. It is to
12 be appreciated that the illustrated network connections are exemplary and
13 that other means of establishing communication link(s) between the
14 computers 502 and 548 can be employed.

15 In a networked environment, such as that illustrated with computing
16 environment 500, program modules depicted relative to the computer 502, or
17 portions thereof, may be stored in a remote memory storage device. By way
18 of example, remote application programs 558 reside on a memory device of
19 remote computer 548. For purposes of illustration, application programs and
20 other executable program components such as the operating system are
21 illustrated herein as discrete blocks, although it is recognized that such
22 programs and components reside at various times in different storage
23 components of the computing device 502, and are executed by the data
24 processor(s) of the computer.

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1 Various modules and techniques may be described herein in the
2 general context of computer-executable instructions, such as program
3 modules, executed by one or more computers or other devices. Generally,
4 program modules include routines, programs, objects, components, data
5 structures, etc. that perform particular tasks or implement particular abstract
6 data types. Typically, the functionality of the program modules may be
7 combined or distributed as desired in various embodiments.

8 An implementation of these modules and techniques may be stored on
9 or transmitted across some form of computer readable media. Computer
10 readable media can be any available media that can be accessed by a
11 computer. By way of example, and not limitation, computer readable media
12 may comprise “computer storage media” and “communications media.”

13 “Computer storage media” includes volatile and non-volatile,
14 removable and non-removable media implemented in any method or
15 technology for storage of information such as computer readable
16 instructions, data structures, program modules, or other data. Computer
17 storage media includes, but is not limited to, RAM, ROM, EEPROM, flash
18 memory or other memory technology, CD-ROM, digital versatile disks
19 (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic
20 disk storage or other magnetic storage devices, or any other medium which
21 can be used to store the desired information and which can be accessed by a
22 computer.

23 “Communication media” typically embodies computer readable
24 instructions, data structures, program modules, or other data in a modulated
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1 data signal, such as carrier wave or other transport mechanism.
2 Communication media also includes any information delivery media. The
3 term “modulated data signal” means a signal that has one or more of its
4 characteristics set or changed in such a manner as to encode information in
5 the signal. By way of example, and not limitation, communication media
6 includes wired media such as a wired network or direct-wired connection,
7 and wireless media such as acoustic, RF, infrared, and other wireless media.
8 Combinations of any of the above are also included within the scope of
9 computer readable media.

10 Fig. 7 shows functional components of one embodiment of the game
11 console 102 as shown in Fig. 1 in more detail (e.g., the Xbox® video game
12 system as produced and distributed by Microsoft Corporation). The game
13 console 102 has a central processing unit (CPU) 600 and a memory
14 controller 602 that facilitates processor access to various types of memory,
15 including a flash ROM (Read Only Memory) 604, a RAM (Random Access
16 Memory) 606, a hard disk drive 608, and a portable media drive 609. CPU
17 600 can for example be equipped with a level 1 cache 610 and a level 2
18 cache 612 to temporarily store data and hence reduce the number of memory
19 access cycles, thereby improving processing speed and throughput.

20 CPU 600, memory controller 602, and various memory devices are
21 interconnected via one or more buses, including serial and parallel buses, a
22 memory bus, a peripheral bus, and a processor or local bus using any of a
23 variety of bus architectures. By way of example, such architectures can
24 include an Industry Standard Architecture (ISA) bus, a Micro Channel
25

1 Architecture (MCA) bus, an Enhanced ISA (EISA) bus, a Video Electronics
2 Standards Association (VESA) local bus, and a Peripheral Component
3 Interconnects (PCI) bus also known as a Mezzanine bus.

4 As one suitable implementation, CPU 600, memory controller 602,
5 ROM 604, and RAM 606 are integrated onto a common module 614. In this
6 implementation, ROM 604 is configured as a flash ROM that is connected to
7 the memory controller 602 via a PCI (Peripheral Component Interconnect)
8 bus and a ROM bus (neither of which are shown). RAM 606 is configured
9 as multiple DDR SDRAM (Double Data Rate Synchronous Dynamic RAM)
10 that are independently controlled by the memory controller 602 via separate
11 buses (not shown). The hard disk drive 608 and portable media drive 609
12 are connected to the memory controller via the PCI bus and an ATA (AT
13 Attachment) bus 616.

14 A 3D graphics processing unit 620 and a video encoder 622 form a
15 video processing pipeline for high speed and high resolution graphics
16 processing. Data is carried from the graphics processing unit 620 to the
17 video encoder 622 via a digital video bus (not shown). An audio processing
18 unit 624 and an audio codec (coder/decoder) 626 form a corresponding
19 audio processing pipeline with high fidelity and stereo processing. Audio
20 data is carried between the audio processing unit 624 and the audio codec
21 626 via a communication link (not shown). The video and audio processing
22 pipelines output data to an A/V (audio/video) port 628 for transmission to
23 the television or other display. In the illustrated implementation, the video
24 and audio processing components 620-628 are mounted on the module 614.

25

Also implemented on the module 614 are a USB host controller 630 and a network interface 632. The USB host controller 630 is coupled to the CPU 600 and the memory controller 602 via a bus (e.g., PCI bus) and serves as host for the peripheral controllers 636(1)-636(4). The network interface 632 provides access to a network (e.g., Internet, home network, etc.) and may be any of a wide variety of various wire or wireless interface components including an Ethernet card, a modem, a Bluetooth module, a cable modem, and the like.

The game console 102 has two dual controller support subassemblies 640(1) and 640(2), with each subassembly supporting two game controllers 636(1)-636(4). A front panel I/O subassembly 642 supports the functionality of a power button 631 and a media drive eject button 633, as well as any LEDs (light emitting diodes) or other indicators exposed on the outer surface of the game console. The subassemblies 640(1), 640(2), and 642 are coupled to the module 614 via one or more cable assemblies 644.

Eight memory units 634(1)-634(8) are illustrated as being connectable to the four controllers 636(1)-636(4), i.e., two memory units for each controller. Each memory unit 634 offers additional storage on which games, game parameters, and other data may be stored. When inserted into a controller, the memory unit 634 can be accessed by the memory controller 602.

A system power supply module 650 provides power to the components of the game console 102. A fan 652 cools the circuitry within the game console 102.

1 A console user/player interface (UI) application 660 is stored on the
2 hard disk drive 608. When the game console is powered on, various
3 portions of the console application 660 are loaded into RAM 606 and/or
4 caches 610, 612 and executed on the CPU 600. Console application 660
5 presents a graphical user/player interface that provides a consistent
6 user/player experience when navigating to different media types available on
7 the game console.

8 Game console 102 implements a cryptography engine to perform
9 common cryptographic functions, such as encryption, decryption,
10 authentication, digital signing, hashing, and the like. The cryptography
11 engine may be implemented as part of the CPU 600, or in software stored on
12 the hard disk drive 608 that executes on the CPU, so that the CPU is
13 configured to perform the cryptographic functions. Alternatively, a
14 cryptographic processor or co-processor designed to perform the
15 cryptographic functions may be included in game console 102.

16 Game console 102 may be operated as a standalone system by simply
17 connecting the system to a television or other display. In this standalone
18 mode, game console 102 allows one or more players to play games, watch
19 movies, or listen to music. However, with the integration of broadband
20 connectivity made available through the network interface 632, game
21 console 102 may further be operated as a participant in online gaming, as
22 discussed above.

23 Although systems, media, methods, approaches, processes, etc. have
24 been described in language specific to structural and functional features
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1 and/or methods, it is to be understood that the invention defined in the
2 appended claims is not necessarily limited to the specific features or
3 methods described. Rather, the specific features and methods are disclosed
4 as exemplary forms of implementing the claimed invention.

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